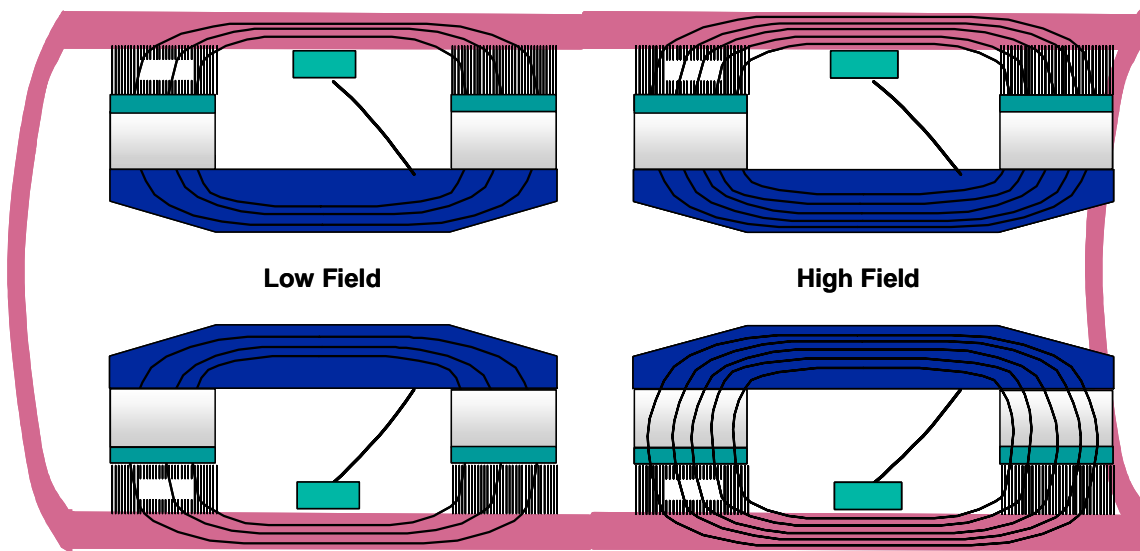


**Mechanical Damage Inspection Using MFL Technology**  
**Agreement DTRS56-02-T-0002**  
**4th Quarterly Status Report**  
**Period July 1 to September 30, 2003**  
**Contractor: Battelle**

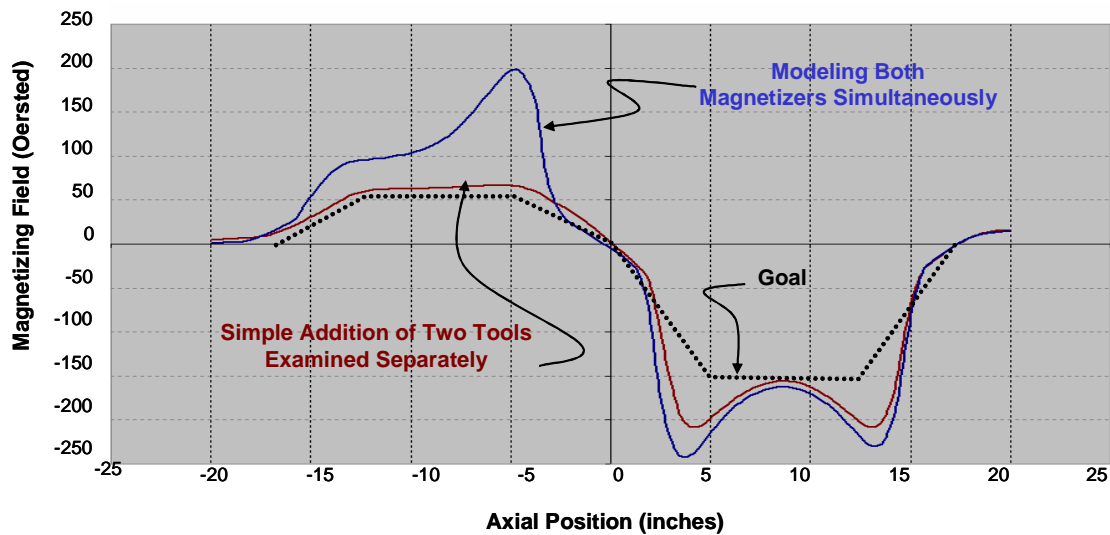
The goal of this project is design an improved magnetic flux leakage inspection system for mechanical damage. This status report describes the magnetic finite element modeling of the high and low field magnetizer. To evaluate design improvements, a model of a standard two magnetizer system was established. This two magnetizer design, illustrated in Figure 1, is technically feasible to apply the dual magnetization technology developed in the prior program, but has not been commercially accepted because it increases the size of the tool to unacceptable lengths.



**Figure 1. Two-magnetizer implementation of mechanical damage inspection technology.**

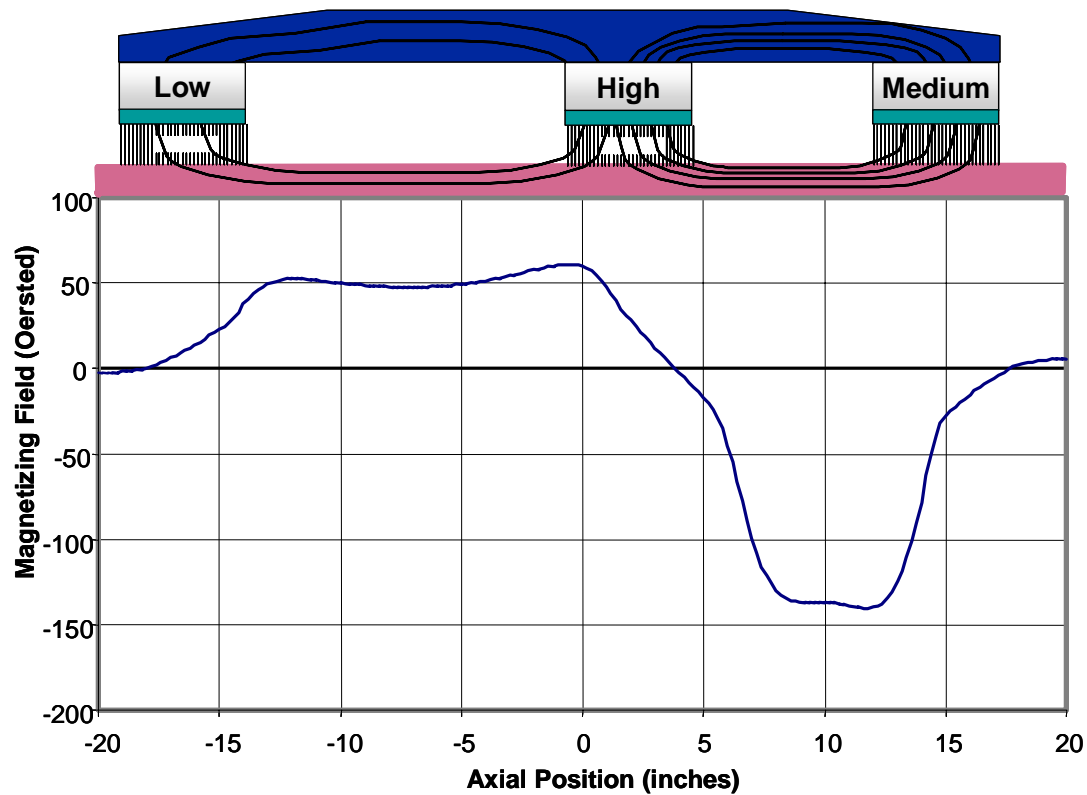
When implementing this design, care must be taken to ensure one magnetizer has minimal effect on the other. This is illustrated in Figure 2. The goal of the dual magnetization inspection technology is to inspect at a high magnetization level, between 120 and 160 Oersted and a low level, between 50 and 70 Oersted. To attain consistent signals, a zone of constant magnetization over several inches is desired. If the two magnetizers are far apart, the design goal is nearly met with a large zone of constant magnetization at low magnetization and a smaller but adequate zone at high magnetization. Because the pipe is near magnetic saturation at high magnetization levels, a long zone cannot be attained. However, when the two magnetizers are placed next to each other, interactions occur. As illustrated in Figure 2, the low field slightly increases the high

field, but more importantly, the high field distorts the zone of constant magnetization for low magnetization levels.



**Figure 2. Model results for a two-magnetizer implementation of mechanical damage inspection method**

The goal of this project is to establish a simpler more compact magnetizer design that successfully performs a high and low field level inspection. Modeling has begun on various designs that use three magnet poles. A typical result is shown in Figure 3. For this implementation, a strong magnetic pole is in the center, a weak one is at the left and a moderate strength pole is on the right. This result provides the desired field levels for mechanical damage characterization. Additional modeling will be required to examine the many inspection variables such as wall thickness, velocity, pipe diameter, and material properties.



**Figure 3. Model result for a three pole magnetizer implementation of mechanical damage inspection method**

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